

Figure 1: A schematic diagram of a 1D chain of coupled harmonic oscillators. The chain consists of  $N$  particles, each represented by a circle with a dot in the center. The particles are connected by horizontal lines representing springs. The distance between adjacent particles is labeled  $a$ . The mass of each particle is labeled  $m$ . The spring constant is labeled  $k$ . The displacement of the  $i$ -th particle from its equilibrium position is labeled  $u_i$ . The total length of the chain is labeled  $L$ . The diagram is labeled "Figure 1" at the bottom.

[illegible]

**Abstract**